REMARKS

Applicants appreciate the thorough examination of the present application that is reflected in the Official Action of August 9, 2005. Applicants also appreciate the Examiner's indication that Claims 3, 4, 10 and 11 would be allowable if rewritten in independent form, and that Claims 12-27 are allowed. It would be relatively easy for Applicants to merely rewrite Claims 3, 4, 10 and 11 in independent form to place the present application in condition for allowance. However, upon careful study, Applicants respectfully request that independent Claim 1 is patentable over U.S. Patent 6,437,383 to Xu. In particular, as will be shown below, Xu appears to describe that the <u>electrodes</u> that are electrically connected to a phase changeable material pattern include nitrogen atoms therein, but does not appear to describe or suggest that the phase changeable material <u>itself</u> contains nitrogen atoms therein. For at least these reasons, Applicants respectfully submit that Claim 1 is patentable over Xu, and that the present application is in condition for allowance.

<u>The Restriction Requirement Is Not Being Traversed</u>

Applicants hereby affirm the provisional election that was made to prosecute the invention of Group I, Claims 1-27, and acknowledge that Claims 28-50 are withdrawn from further consideration, as being drawn to a non-elected invention. The title has been changed to conform to the elected device claims.

<u>Claims 1-2 and 5-9 Are Patentable Over Xu</u>

Claim 1 recites:

> 1. A phase-changeable memory device, comprising:
> a phase-changeable material pattern of <u>a phase-changeable material that includes nitrogen atoms</u>; and
> first and second electrodes electrically connected to the phase-changeable material pattern and provide an electrical signal thereto.
> (Emphasis added.)

Claim 1 stands rejected as being anticipated by Xu. The Official Action correctly indicates at Page 4 that Xu's phase changeable material pattern is noted by reference number **290** and that an electrode is denoted by **230**. The Official Action cites Xu Figure 18, Column 8, lines 55-63 and Column 10, lines 17-64, as describing a phase changeable material pattern that includes nitrogen atoms. However, Applicants respectfully submit that these passages

describe that the electrode **230** contains nitrogen atoms, but does not describe or suggest that the phase changeable material itself includes nitrogen atoms. In particular, Column 8, lines 55-63 recites:

> The introduction is conformal in the sense that metal compound film **230** is introduced along the side walls and base of trench **220** such that metal compound film **230** is in contact with reducer material **170**. <u>The conformal introduction of metal compound film **230**</u> that is the inventive polysilicon, <u>metal nitride</u> and/or silicide compound may follow conventional introduction techniques known to those skilled in the art including chemical vapor deposition (CVD) techniques. (Emphasis added.)

As clearly shown by the above passage, the electrode **230** may be a metal nitride, but this passage provides no description or suggestion that the phase changeable material **290** itself can include nitrogen atoms. See also the preceding paragraph of Xu at Column 8, lines 43-54:

> FIG. **15** illustrates the inventive process of forming a lower electrode in a phase-change memory device by using the inventive metal compound film. The memory line stack may be referred to as an active area. FIG. **15** shows the structure of FIG. **14** after the conformal introduction of a <u>lower electrode material **230** that may be referred to as a metal compound film</u>, although it may be a conductive or semiconductive polysilicon material or a metal compound material. In one example, <u>metal compound film **230** is a metal nitride compound such as TaN</u> that, depending upon the desired resistivity, may be provided in either stoichiometric or other metal compound film solid solution ratios. (Emphasis added.)

As to the phase changeable material **290**, Xu Column 10, lines 17-64 states:

> FIG. **17** shows the structure of FIG. **16** after the introduction of a volume of memory material **290** (represented as memory element **30** in FIG. **1**). In one example, <u>memory material **290** is a phase change material. In a more specific example, memory material **290** includes a chalcogenide element(s). Examples of phase change memory material **290** include, but are not limited to, compositions of the class of tellerium-germanium-antimony ($Te_x Ge_y Sb_z$) material in both stoichiometric and solid-solution ratios</u>. The volume of memory material **290**, in one example according to current technology, is introduced and patterned with a thickness in a range from about 300 Å to about 6,000 Å.
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> Overlying the volume of memory material **290** in the structure of FIG. **17** are <u>barrier materials **300** and **310** of, for example, Titanium (Ti) and Titanium Nitride (TiN), respectively. The barrier materials serve, in one aspect, to inhibit diffusion between the volume of memory material **290** and second conductor or signal line material overlying the volume of memory material **290** (e.g., second electrode **10**)</u>. Overlying barrier

> materials **300** and **310** is second conductor or signal line material **315**. In this example, second conductor or signal line material **315** serves as an address line, a column line (e.g., column line **10** of FIG. 1). Second conductor or signal line material **315** is patterned to be, in one embodiment, generally orthogonal to first conductor or signal line material **140** (column lines are orthogonal to row lines). Second conductor or signal line material **315** is, for example, an aluminum material, such as an aluminum alloy. Methods for the introduction and patterning of the barrier materials and second conductor or signal line material **315** include such techniques as known to those of skill in the art.
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> FIG. **18** shows the structure of FIG. **17** after the introduction of dielectric material **330** over second conductor or signal line material **315**. Dielectric material **330** is, for example, SiO_2 or other suitable material that surrounds second conductor or signal line material **315** and memory material **290** to electronically isolate such structure. Following introduction, dielectric material **330** is planarized and a via such as a contact corridor is formed in a portion of the structure through dielectric material **330**, dielectric material **210**, and masking material **180** to reducer material **170**. The via is filled with conductive material **340** such as tungsten (W) and barrier material **350** such as a combination of titanium (Ti) and titanium nitride (TiN). Techniques for introducing dielectric material **330**, forming and filling conductive vias, and planarizing are known to those skilled in the art. (Emphasis added.)

The first passage underlined above explains that the phase changeable material includes a chalcogenide element, for example of the class tellurium-germanium-antimony, but does not describe or suggest that nitrogen atoms can be contained therein. The second underlined passage above clearly describes that an overlying barrier material **310** can include titanium nitride. However, this passage also states that the barrier materials inhibit diffusion, so that this passage actually appears to teach away from providing nitrogen atoms in the phase changeable material pattern itself.

For at least the above reasons, Claim 1 is not anticipated by Xu, and Xu actually appears to teach away from the recitations of Claim 1. Claim 2 also is independently patentable, because Claim 2 recites that the phase changeable material pattern has a polycrystalline structure. The Official Action cites Xu Column 10, lines 17-28 and Column 12, lines 6-10 as teaching this recitation. However, Xu Column 10, lines 17-28 was quoted above, and does not contain any description of a polycrystalline structure. Moreover, Xu Column 12, lines 6-10 states:

> Another advantage exists where a metal compound electrode is used. Because a metal-to-metal interface exists between the lower electrode and the volume of memory material, a lower interface

> resistance may exist that that of a doped polysilicon-chalcogenide interface

This passage states that doped polysilicon may be used to interface with the phase changeable material, but does not describe that the phase changeable material itself has a polycrystalline structure. For at least these reasons, Claim 2 is independently patentable.

Claims 5-9 are patentable at least per the patentability of the independent claim from which they depend.

New dependent Claims 51 and 52 also have been added. Support for these new claims may be found, for example, in Figure 4 of the present application and the description thereof at Page 10, lines 2-10 of the specification. These claims are independently patentable for the reasons that are described in the specification.

Conclusion

Applicants again appreciate the thorough examination of the present application and the indication that many of the claims are allowed or allowable. Applicants have now shown, however, that Claim 1 also is patentable over Xu, and that Claim 2 is independently patentable. Accordingly, Applicants respectfully request withdrawal of all of the outstanding rejections and allowance of the present application.

Respectfully submitted,

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Date of Signature: November 9, 2005